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MSAPC ADVISORY CIRCULAR

U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF AIR AND WASTE MANAGEMENT ●

MOBILE SOURCE AIR POLLUTION CONTROL

A/C NO. 26-B

January 7, 1977

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SUBJECT: Representativeness of Unleaded Service Accumulation
Fuels

A. Purpose

The purpose of this Advisory Circular is to interpret 40 CFR 86.113-78(a)(2), which requires that fuel representative of commercial gasoline which will be generally available through retail outlets shall be used in service accumulation for gasoline-fueled vehicles. Section 86.777-6(b) provides the same regulatory requirement for the fuel used in service accumulation for gasoline-fueled heavy-duty engines, and this Advisory Circular applies equally to that section. Advisory Circular No. 26-A is obsolete and should be discarded.

B. Background

1. Advisory Circular No. 26-A established minimum levels of lead and phosphorus that must be contained in unleaded service accumulation fuel. With the revision of the governing regulation (40 FR 33973, August 13, 1975), all requirements for specific minimum levels of lead and phosphorus in unleaded service accumulation fuel were removed. However, the general requirement that service accumulation fuel be representative of commercial fuel which will be available in retail outlets was not changed. EPA has interpreted this provision as regards lead and phosphorus to mean that manufacturers' specifications for service accumulation fuel could not contain a requirement that the fuel be lead- or phosphorus-sterile.

2. Information now available on certain other constituents typically present in unleaded fuel available in retail outlets, and expected to be in such fuel in the future, makes it necessary to issue updated guidelines about the composition of fuels that EPA will deem to be in compliance with the regulatory requirement. Specifically, certain minimum levels of methylcyclopentadienyl manganese tricarbonyl (MMT) and of sulfur must be present in unleaded service accumulation fuel in order for these fuels to be deemed to be in compliance with 40 CFR 86.113-78(a)(2) and 40 CFR 86.777-6(b).

C. Applicability

The policy reflected in this Advisory Circular will apply to the certification testing of 1979 and later model year gasoline-fueled vehicles and engines which use unleaded fuels, except insofar as lead and phosphorus are concerned. The criteria

restated herein regarding lead and phosphorus content of unleaded service accumulation fuels, which has applied to 1978 and earlier model year gasoline-fueled vehicles and engines, will continue to be applied to 1979 and later model year gasoline-fueled vehicles and engines without change.

D. Discussion

1. MMT

a. EPA has examined the available information regarding the possible effects of MMT on catalytic emission control systems and on other engine components. This information, although quantitatively inconclusive as to the degree of adverse effects of MMT on such systems, does indicate that there may be some effects due to the use of MMT in unleaded fuels. Unleaded fuel containing MMT is suspected in one experiment ^{1/} to have caused the plugging of a monolith catalyst mounted close to the exhaust manifold (start catalyst), resulting in that catalyst becoming ineffective and in the engine experiencing elevated exhaust system backpressures. Another study ^{2/} has shown changes in engine-out hydrocarbon emissions on a catalyst vehicle operated for 50,000 miles on fuel containing 0.13 grams manganese per gallon. Although hydrocarbon emissions from the engine itself changed, no changes in tailpipe hydrocarbon emissions occurred. Another study by GM ^{1/} showed increased exhaust system backpressure on three out of four pelleted catalyst vehicles operated on fuels containing 0.12 grams manganese per gallon.

b. Certification regulations require that certification test vehicles and engines be operated in service accumulation using fuels that are representative of fuels that will likely be available in commercial outlets. This regulatory requirement was established to assure that certification test vehicles and engines are operated to the maximum degree possible under conditions that are likely to be experienced in use.

c. In view of the available information about MMT, the addition of MMT to certification service accumulation fuels should be accomplished as soon as possible, since MMT usage is widespread and increasing. However, since most fuels have already been obtained by the manufacturers for 1978 model year certification and since many manufacturers have already begun service accumulation on 1978 model year test vehicles and engines, the 1979 model year certification program has been determined to be the earliest practical date for implementing such a requirement. Thus, rather than require manufacturers to specifically blend small lots of fuel with MMT, and to avoid disqualifying test vehicles or engines for which testing has already begun, EPA will defer until the 1979 model year certification a specific requirement that unleaded service accumulation fuel contain designated levels of MMT.

2. Sulfur

a. Both ERDA (Bartlesville Energy Research Center, formerly part of the Bureau of Mines) and the Motor Vehicle Manufacturers Association (MVMA) conduct fuel surveys about four times a year. These surveys are based on several hundred fuel samples taken from all portions of the country. The most recent MVMA survey ^{3/} was taken during the summer of 1976 in 23 cities and involved 227 samples of unleaded fuel. These samples contained an average of 0.029 weight percent sulfur. Earlier MVMA surveys ^{4/} taken in the winter of 1975-76 and the summer of 1975 showed unleaded fuel to have an average sulfur content of about 0.03 weight percent. All

three MVMA surveys agree well with the two most recent ERDA surveys 5/ taken in the winter of 1975-76 and the summer of 1975. Therefore, unleaded fuel sulfur levels have been about 0.03 weight percent for several years. There is no reason to expect significant changes in this level in the next several years.

b. In 1973, General Motors Corporation performed some experiments that showed fuel sulfur compounds seriously poison base metal pelleted catalysts. 6/ EPA is aware of no thorough studies made concerning the effect of fuel sulfur compounds on noble metal catalysts. While there are no data suggesting that serious catalyst poisoning will result from sulfur, it is also not known if fuel sulfur compounds affect noble metal catalysts to less serious degrees. Finally, it is not known if fuel sulfur compounds affect three-way catalyst system components such as the oxygen sensor or the catalyst itself. It is known that fuel sulfur compounds cause a rapid deterioration of certain reduction catalysts containing nickel. 7/ Thus the possibility of an adverse effect makes it necessary to assure that unleaded mileage accumulation fuel contains representative levels of sulfur.

E. Basis for Determination of the Required Level of MMT and Sulfur

1. MMT

a. MMT is currently present in more than 10 percent of the unleaded fuel sold nationwide. Discussions with the major manufacturer of MMT, Ethyl Corporation, and with some elements of the oil industry have indicated that MMT will be added to unleaded fuels in increasing concentrations in the near future as the oil industry begins to be required to supply fuels of lower lead content than those currently supplied. One major oil industry member had indicated that "[w]e cannot, of course, speak for other gasoline producers with regard to usage of manganese. However, we would expect other companies also faced with octane capacity limitations resulting from the lead phase down regulations to make use of such MMT (up to the recommended maximum 0.125 g/gal.) as is available." 8/

b. The major manufacturer of MMT has recommended that MMT be used in concentrations of 0.125 grams manganese per gallon. This recommended concentration of MMT is based on an Ethyl Corporation study of the costs of adding MMT to unleaded fuels versus the benefits (in octane number improvements) which result. The addition of MMT in concentrations of 0.125 grams manganese per gallon yields a Research octane number increase of about two. The addition of more MMT increases the octane rating, but at a slower rate. Nevertheless, for small refineries, or for refineries which are limited with regard to octane capability, the potential exists for the addition of MMT in amounts greater than the concentration recommended by the manufacturer.

c. Even though the average concentration of MMT in commercial unleaded fuel at the time the 1979 model year vehicles are introduced is anticipated to be somewhat less than 0.125 grams manganese per gallon due to supply problems 8/, it is expected that over the useful lives of 1979 (and later) model year vehicles the concentration of MMT in commercial fuel will increase so that most if not all of those vehicles will be operated for most of their useful lives on unleaded fuels containing 0.125 grams manganese per gallon. Thus, EPA has selected an MMT concentration of 0.125 grams manganese per gallon as the concentration which will represent the MMT concentration of commercial unleaded fuels to which a significant portion of vehicles will be exposed.

d. Since EPA has concluded that commercially available unleaded fuels will be blended with MMT concentrations of 0.125 grams manganese per gallon, fuels with this level should be used in service accumulation. Fuel MMT levels should be measured by the Ethyl method EAM-128-74, or by such other method shown to be equivalent and approved by EPA. The EAM-128-74 method is accurate to within 10 percent of the fuel manganese level to be measured. For 0.125 grams manganese per gallon, the measurement accuracy of about 10 percent results in an acceptable tolerance of 0.01 grams manganese per gallon. To allow for this level of accuracy, unleaded service accumulation fuels should have a measured MMT content within the range 0.115 to 0.135 grams manganese per gallon. This requirement will assure a resulting average MMT content of 0.125 grams manganese per gallon.

2. Sulfur

a. Extensive surveys by both ERDA and MVMA show the average sulfur level of unleaded fuel in most parts of the U.S. to be about 0.03 weight percent. Therefore, this sulfur level should be used in unleaded fuel used for service accumulation of certification vehicles and engines. This will assure that fuel is representative of commercially available fuels as required by 40 CFR 86.113-78(a)(2) and 86.777-6(b).

b. Fuel sulfur levels should be measured by ASTM method D-2622 (X-Ray fluorescence) or such other method shown to be equivalent and approved by EPA. For 0.03 weight percent sulfur fuel, the measurement accuracy of the D-2622 method is 16 percent, which results in an acceptable tolerance of 0.005 weight percent sulfur. To allow for this level of accuracy, unleaded service accumulation fuel should have a minimum measured sulfur level of 0.025 weight percent. This requirement will assure a resulting average sulfur level of 0.03 weight percent.

c. The most appropriate fuel to meet the intent of this Advisory Circular would be one that comes out of the refining process with at least 0.025 weight percent sulfur. However, it is possible that fuel from some refiners may contain less than 0.025 weight percent sulfur and would require the addition of sulfur compounds to meet the representativeness requirement of 40 CFR 86.113-78(a)(2) and 86.777-6(b). The compounds that are added to this fuel should be representative of the type of compounds currently found in commercial fuels. Suitable compounds include thiophene and di-tertiarybutyl-disulfide. Other sulfur-containing compounds may be used if approved by EPA.

F. Minimum Levels of MMT and Sulfur in Unleaded Service Accumulation Fuel

To be deemed in compliance with 40 CFR 86.113-78(a)(2) and 86.777-6(b), unleaded service accumulation fuel must comply with the following specifications for MMT and sulfur content:

MMT	0.115 to 0.135 grams manganese per gallon, as measured by Ethyl method EAM-128-74, or equivalent method.
Sulfur	0.025 weight percent minimum, as measured by ASTM method D-2622, or equivalent method.

G. Approval of Manufacturers' Service Accumulation Fuels

Beginning with model year 1979 certification, EPA will not approve service accumulation fuel unless the specifications for such fuel include MMT in a range of 0.115 to 0.135 grams manganese per gallon and at least 0.025 weight percent sulfur. As regards lead and phosphorus, although no specific concentrations are required, EPA will not approve service accumulation fuels if the specifications for such fuels call for lead- or phosphorus-sterile fuel.

H. Assurance of Compliance with Specifications for Unleaded Service Accumulation Fuels

EPA intends from time to time to test samples of service accumulation fuel to check that the fuels are within the ranges specified above. A determination that unleaded fuel does not contain MMT and sulfur within the ranges specified in this Advisory Circular may result in the disqualification of all data generated by any service accumulation test vehicles or engines which used fuel not meeting these requirements.

I. Unleaded Certification Testing Fuels

Since EPA at the present time has no indication of any immediate effects of MMT or sulfur on the exhaust or evaporative emission levels of vehicles, EPA does not require minimum concentrations of MMT or sulfur in unleaded test fuels. EPA will continue to monitor information on such immediate effects of MMT or sulfur on exhaust or evaporative emissions, and if such effects are determined to exist will take action to amend the regulatory specifications for unleaded test fuels to require the addition of MMT and sulfur.

Mobile Source Air Pollution Control

1/ General Motors Corporation letter to John P. DeKany, EPA, August 31, 1976.*

2/ Ethyl Corporation letter to John P. DeKany, EPA, September 15, 1976.*

3/ MVMA National Fuel Survey, Summer 1976.

4/ MVMA National Fuel Survey, Winter 1975-76, and

MVMA National Fuel Survey, Summer 1975.

5/ Ella Mae Shelton, "Motor Gasolines, Summer 1973", Bartlesville Energy Research Center, January 1976, and

Ella Mae Shelton, "Motor Gasolines, Winter 1975-1976", Bartlesville Energy Research Center, June 1976.

- 6/ Joseph E. Hunter, "Studies of Catalyst Degradation in Automotive Emission Control Systems," SAE paper 720122, SAE Detroit Meeting, January 1972.
- 7/ EPA-OMSAPC Contract No. 68-03-2161 with Gould Industries, Contract in progress.
- 8/ EXXON Research and Engineering Company letter to John P. DeKany, EPA, September 9, 1976.*

* References available for public inspection at EPA's Public Information Reference Unit, 401 M Street, S. W., Washington, D.C. 20460.